SOME TYPES OF EGGS DEPOSITED BY MOTHS, HETEROCERA-LEPIDOPTERA [1]

ALVAH PETERSON

For the past six or more years the author has been working with eggs of insects. Recently he has paid special attention to eggs of moths. To date the eggs from more than 150 species representing some 35 or more families of moths have been collected, photographed, preserved and described; also a rough sketch of each species has been made. The investigation thus far shows that distinctive types exist, also characteristics common to many species are present.

In this article some of the types and common characteristics are shown. In later publications the author hopes to present more detailed information on species of given genera and families.[2]

EGG DEPOSITION

Most moths deposit their eggs on a host plant or in the vicinity of food which the larvae will consume upon hatching. Many species deposit single isolated eggs but the majority deposit their eggs in groups. The most simple mass occurs where a female deposits 10 to 100 or more eggs in a continuous flat group (9)[3] in such a manner that each egg is separated from others usually by a distance that does not exceed the greatest diameter of a single egg. Other species deposit continuous flat masses of firmly constructed eggs where every egg is in contact with one to five eggs (10) and all are sealed together by a strong adhesive. When pliable eggs are deposited in a continuous flat mass the eggs within the mass and away from the border may assume irregular shapes (11), most frequently hexagonal.

When species, possessing scale-like eggs, deposit them in a mass (12) the eggs often overlap considerably yet none in the mass is completely covered by other eggs. Among a few species the females deposit a compact mass of eggs consisting of several layers or eggs are scattered in an irregular manner. Usually these are mixed with bits of wax or froth-like secretions produced by the female as she oviposits (17).

EGG SIZES AND SHAPES

Eggs of moths vary in size, the smallest being approximate 0.3 mm. in diameter and the largest seen to date 2.8 mm. in length. The size of an egg mass may be 3 mm. to 40 mm. or more in length.

The over all shape of a single moth egg is frequently spherical (1) or oval (7). Others are rod-shaped (4), barrel or cone-like (6), spindle-shaped (3) or scale-like (2). Oval eggs from a top view may be ovid while others resemble thick oval wafers (5) with flattened upper and lower surfaces.

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[1] This investigation was supported by a research grant from the National Science Foundation assigned to the Ohio Historical Society State Museum, Columbus, Ohio. Many of the eggs used in this study were collected in Florida when the author was associated with the State Plant Board, Gainesville, Florida, 1959-1960. The author is indebted to C. P. Kimball for the determination of the species of moths from which eggs were obtained.

[2] Information on collecting, preserving, and photographing eggs of moths was given in the recent article by Alvah Peterson, 1960. Photographing eggs of insects, Florida Entomologist, 43(1): 1-7.

[3] Numbers in parentheses refer to figures.

Most eggs of all shapes possess a narrow to broad, flattened base or lower surface which is adjacent to the substrate on which they rest. Single isolated eggs (4) or those which are firmly constructed in a mass (10) usually are fairly constant in size and shape for a given species. When eggs in a mass are pliable (11) their shapes may vary somewhat.

Color

The color of some moth eggs may be due to pigment located in the chorion. This is true of thick-shelled eggs among Citheroniidae and Saturniidae (8), which undergo little or no color change during their incubation period.

Eggs of many species in numerous families possess a chorion that is translucent, in some cases almost transparent. This is especially noticeable when the eggs are deposited on clear glass or polyethylene. If highly translucent eggs are deposited on green foliage the color of the leaf or substrate can be seen through the eggs. Among many species the color of the embryonic tissue within is visible (24). This is particularly obvious when portions of the cytoplasm and embryo change in color as the larva develops. For example among many Phalaenidae red to brown pigment areas appear as irregular blotches or rings around the margin (26) a few days previous to hatching. Among other families, especially the Tortricidae, Olethreutidae, Pyralidae, Arctiidae, Notodontidae and others, some species possess first instar larvae with dark-colored heads and, in some cases, black setae (14) which, prior to hatching, can be seen through the chorion. When eggs are in this state of development they are often referred to as the "black spot stage". In general most eggs of moths that possess a thin semi-transparent chorion change color a short time previous to hatching.

Plate I

Figure 1. A spherical chalk-white egg. Egg diameter 1 mm. Notodontidae. *Lophodonta angulosa* (A. and S.)

Figure 2. Two isolated, scale-like, shiny eggs. Egg length 0.75 mm. Olethreutidae. *Bactra verutana* Zell.

Figure 3. An elongated spindle-like egg with a rough semi-transparent chorion. Egg length 1.2 mm. Phaloniidae. *Carolella sartana* (Hbn.)

Figure 4. A single, elongated, rod-like, lemon yellow egg. Egg length 1.1 mm. Lacosomidae, *Lacosoma chiridota* Grt.

Figure 5. Several flattened, oval, wafer-like, orange-colored eggs covered with tiny hexagonal depressions. Egg length 0.7 mm. Geometridae. *Racheospila lixaria* Gn.

Figure 6. Several circular, cone-shaped, green eggs with some vertical ridges terminating in flanges that protrude beyond the micropylar area. Egg length 0.6 mm. Phalaenidae, *Helicontia apicella* (Grt.)

Figure 7. Several oval, smooth, near white eggs. Egg length 0.5 mm. Pterophoridae, *Oidaematophorus balanotes* (Meyr.)

Figure 8. Several rounded, somewhat flattened, cream-white, eggs each with one large or two narrow brown bands about their periphery. Length 2.6 mm. Saturniidae, *Telea polyphemus* (Cram.)

Figure 9. A simple, scattered, cluster of oval, light yellow, eggs on grape foliage. Egg length 0.55 mm. Zygaenidae, *Harrisina americana* (Gue.)

Figure 10. Portion of a compact, flat, mass of firmly constructed, adhesive, chalk-white eggs with bluish centers. Egg diameter 0.8 mm. Notodontidae. *Datana ranaeceps* Guer.

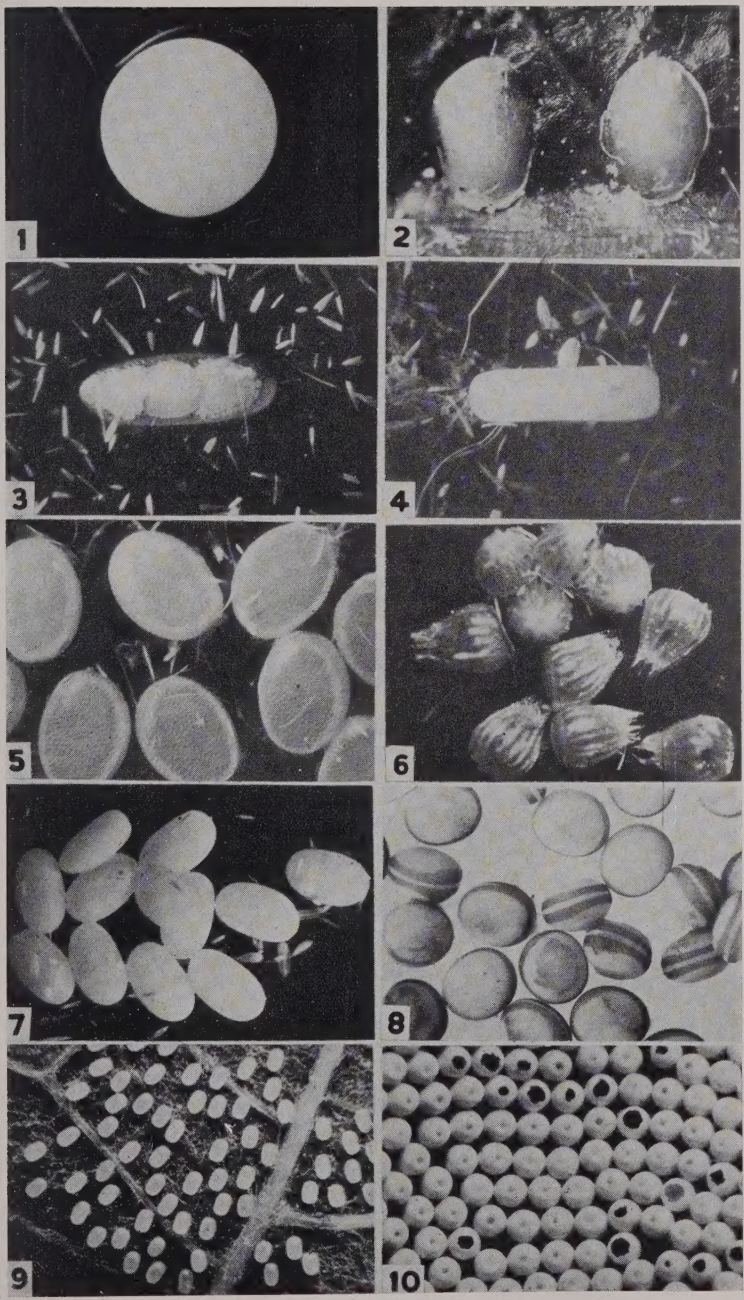


Plate I

The overall color of newly deposited eggs for a given species is fairly constant. It may be some shade of white, yellow, orange, green, blue, red, brown to near black. Near white and shades of yellow and green are the most common colors.

The color of the entire egg among some species may undergo a change 6 to 48 hours after deposition. For example among species of *Acrolophus* (13) a newly deposited egg is near white. Six to 12 hours after deposition the entire egg changes to a dark brown or black. Among species of *Crambus* (23) the color changes from a cream white to orange, pink or red usually within 48 hours after being laid.

Coating on Eggs

Most eggs of moths when deposited are covered with a thin, clear, adhesive coating which soon hardens. This adhesive coating sticks the eggs to the substrate on which they rest and also holds them together (10) if they are adjacent to each other in a mass. The adhesive quality of the coating varies considerably. Some eggs are deposited without an adhesive coating or the coating, if present, is ineffective as an adhesive. These eggs are completely free and roll about if they are deposited in a small glass container. Typically the eggs of several species of *Acrolophus* (13) and *Crambus* (23) are like this.

Plate II

Figure 11. Portion of a cluster of pliable near white eggs that become hexagonal in shape under pressure. Egg diameter 0.55 mm. Pyralidae, *Galleria mellonella* (L.)

Figure 12. A cluster of near-white, oval, flattened, scale-like eggs that overlap like shingles. Egg length 0.65 mm. Pyralidae, *Sericophaga macularae* Riley

Figure 13. Several free (unattached), nearly spherical, shiny eggs, that are near white when deposited, changing to a deep brown or near black within a few hours after deposition. Egg length 0.35 mm. Acrolophidae, *Acrolophus propinquus* (Wlshm.)

Figure 14. An enlarged, nearly spherical egg showing a larval head through the translucent chorion. Egg diameter 1.3 mm. Notodontidae, *Fentonia marthesia* Cram.

Figure 15. Several nearly spherical, greenish-white, chalk-like eggs with green centers and surrounded on all sides with clear, permanent, adhesive bubbles. Egg diameter 0.75 mm. Liparidae, *Olene leucophaea* (A. and S.)

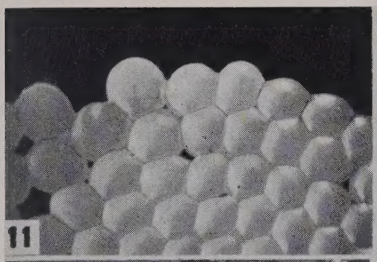
Figure 16. A mass of perpendicular eggs around a cherry twig covered with a brown shiny froth. Egg length 1.0 mm. Lasiocampidae, *Malacosoma americana* (Fabr.)

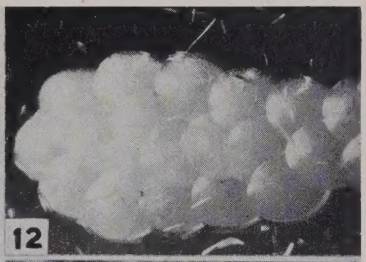
Figure 17. A female tussock moth depositing eggs in the midst of a white froth-like secretion. Egg diameter 0.9 mm. Liparidae, *Hemerocampa leucostigma* (J. E. Smith)

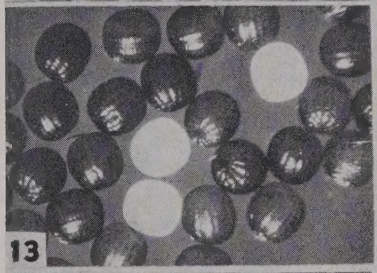
Figure 18. A flat mass of 12 to 18 nearly circular flexable eggs covered with fine, yellow, wax-like secretions. Egg length 0.9 mm. Pyralidae, *Schoenobius melinellus* (Clem.)

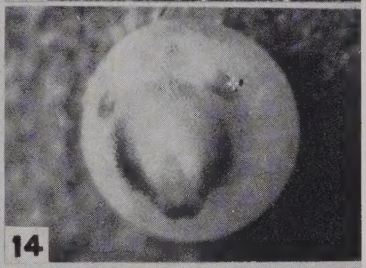
Figure 19. Scattered and bunched light yellow eggs in part covered with numerous yellow waxy hairs. Egg length 1.2 mm. Megalopygidae, *Megalopyge opercularis* (A. and S.)

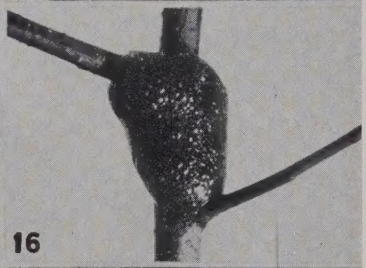
Figure 20. An isolated, flattened, oval, near-white egg coated with and sealed to a substrate by an opaque white adhesive. Egg length 1.0 mm. Pyralidae, *Platytes panalope* Dyas.

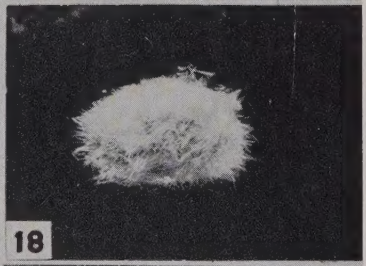


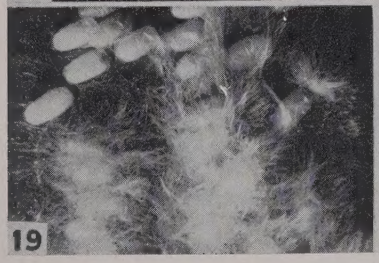












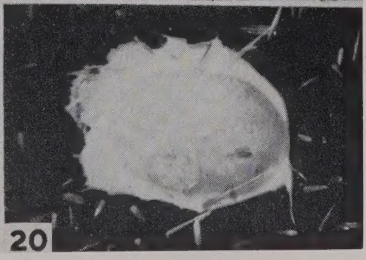


Plate II

Many eggs, possessing an adhesive coating, adhere tightly to plant tissues yet the same eggs if deposited on plastic or polyethylene are not firmly attached and usually fall off the substrate after they are placed in a preservative. Among some species of *Olene* the clear adhesive coating is plentiful and appears as small transparent permanent bubbles (15) between and around the sides of the eggs. In other cases the adhesive coating resembles a whitewash paste (20) which holds the eggs to the substrate and together when in a mass.

Among species of *Malacosoma* a brown, froth-like, adhesive coating (16) is deposited among and over the tops of perpendicular eggs that have been placed in a mass partially or completely around a small twig. Some species of Liparidae (17) and Megalopygidae (19) secrete a loose to thick coating of wax-like froth, small thread-like strands or waxy material over and among eggs in a mass. A similar situation exists among species of *Schoenobius* in that the female deposits a compact, flat layer of eggs (18) and then places over the egg mass long, thin, brown or yellowish, hair-like structures in an irregular or parallel position. These secretions may also be mixed with thin scales apparently sloughed off from the caudal end of the abdomen of the female during deposition.

Plate III

Figure. 21. Several pale yellowish green to orange and pink oval eggs possessing longitudinal rows of small hexagonal depressions. Egg length 0.5 mm. Geometridae, *Melanolophia canadaria* (Gn.)

Figure 22. Several dirty white to chocolate brown, slightly pointed, oval eggs possessing conspicuous irregular depressions, mostly hexagonal. Egg length 2.5 mm. Cossidae, *Prionoxystus robinae* (Pech.)

Figure 23. Numerous free (unattached) eggs, each with 16 to 17 parallel, longitudinal, rounded ridges. These near-white eggs become pink to red within four days. Egg length 0.475 mm. Pyralidae, *Crambus satrapellus* (Zinck.)

Figure 24. A few light yellowish-green, semi-spherical eggs which exhibit a red ring of pigment near the margin previous to hatching. Egg diameter 1.3 mm. Notodontidae, *Heterocampa umbata* Wlk.

Figure 25. Top and side views of several bright green eggs possessing conspicuous vertical ridges and transverse striae. Egg diameter 0.55 mm. Phalaenidae, *Leucania latiscula* H. - S.

Figure 26. Top views of several four-day-old eggs, each with 35 to 38 vertical ridges. They also show reddish-brown, internal, pigment areas. Egg diameter 0.6 mm. Phalaenidae, *Agrotis ypsilon* (Rott.)

Figure 27. Three circular, flattened, near-white eggs with a translucent chorion each possessing 44 to 46 ridges. Egg diameter 0.9 mm. Phalaenidae, *Acronicta longa* Gn.

Figure 28. Side and top views of several pea green eggs each with 29 to 34 vertical ridges and distinct micropylar areas. Egg diameter 0.65 mm. Phalaenidae. *Mocis latipes* Gn.

Figure 29. Top views of several, somewhat flattened, greenish-white eggs each with a narrow border of parallel ridges and a large central area covered with tiny hexagonal depressions. Egg length 0.475 mm. Nolidae, *Celama sorghiella* (Riley)

Figure 30. Top views of several near-white, spiny eggs. Entire egg surface above the base covered with tiny, triangular areas bearing hooked spines at each corner of every triangle. Egg diameter 0.9 mm. Phalaenidae, *Noropsis hieroglyphica* (Cram.)

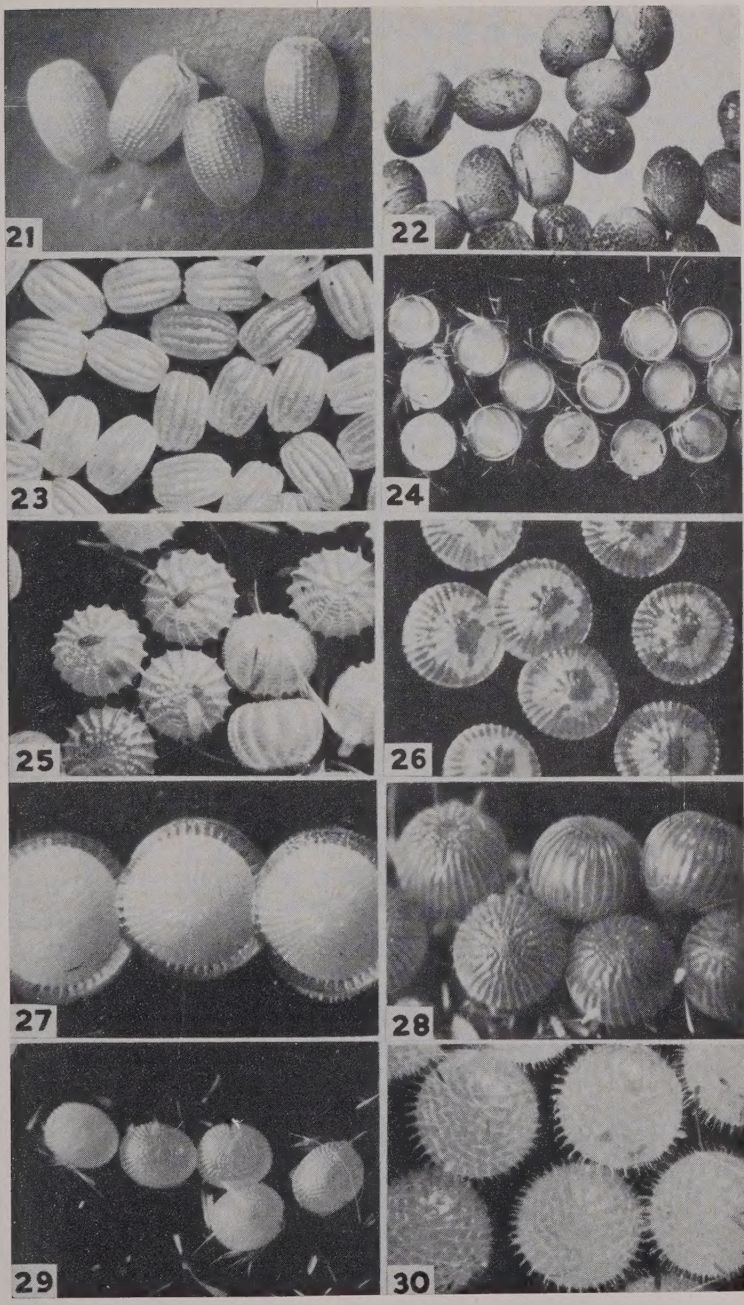


Plate III

Gross Chorion Structure

The outer surface of the chorion on a moth egg may be smooth (1) to rough (22) and brilliant (13) to chalk-like (15). Eggs of some species, that appear to be smooth to the naked eye, may possess microscopic structures only visable when magnified 10 to 25 times. These details vary considerably. Among some species tiny, rounded pimples or dimples are present on most of the exposed surface while among others inconspicuous, irregular, hexagonal depressions occur in rows (21) or scattered (5) over the surface. Eggs of *Prionoxystus* possess conspicuous depressions (22) that may be lopsided squares to hexagons. Each darkened depression is surrounded by a distinct ridge which is frequently lighter in color than the depression.

Many eggs of moths possess parallel ridges on their exterior. These may be vertical or horizontal depending upon the position of the eggs on their substrate. So far as known distinct parallel ridges on moth eggs are always more or less parallel with a line that is perpendicular to the micropylar area of the egg. When the micropylar area is at the top of an egg fixed to a leaf or substrate, the ridges are vertical (28). If the micropylar area is at one end of a free egg resting on its side the ridges are horizontal. Comparatively few eggs are free (unattached). Eggs of *Crambus* (23) and *Acrolophus* (13) are good examples of free eggs that show ridges in a horizontal position.

Most species of Phalaenidae possess eggs firmly attached to a substrate. Their faint to conspicuous parallel ridges are vertical (25-28). Each ridge extends from the top-center or micropylar area to the base or point of attachment of the egg to its substrate. They vary in length and the longest terminate near the micropylar area. The shorter ridges end at lower points or they may join with adjacent ridges. The number of ridges present on the eggs of a given species is more or less constant. Among species seen to date 10 to 56 may be present. Figures (25) and (28) illustrate two species that are different. If the ridges and adjacent grooves are conspicuous, the number per egg is apt to be small (25).

The upper terminals of vertical ridges near the micropylar area are usually inconspicuous. Among species of *Helicontia* the terminals of the longest vertical ridges are prominent (6), often in the form of thin translucent flanges or fringes that protrude some distance above the top surface of the egg. Species possessing ridges often exhibit numerous tiny transverse striae (25) in the grooves between the ridges. These are more or less constant in number for a given species. If nodules or bead-like spots occur along the tops of the ridges the striae usually coincide with these structures. All of the above structures are seen best in living eggs under high magnification or in enlarged micro-photographs or transparencies.

An interesting variation of ridges exists among species of *Celana* (29). These somewhat flattened eggs possess a narrow band of short parallel ridges adjacent and perpendicular to the outer border of the egg. The central micropylar area is large and covered with minute depressed hexagonal areas.

Another unusual feature associated with moth eggs is found on those of some species of *Noropsis* (30). The entire surface of the egg above the base is covered with small triangular areas and each triangle bears hooked spines at its three corners.

EFFECTS OF A SEVERE WINTER ON SURVIVAL OF THE RECENTLY ESTABLISHED PARASITE OF THE RHODESGRASS SCALE IN FLORIDA

D. D. QUESTEL[1] AND W. G. GENUNG[2]

We recently reported on the successful establishment of the Hawaiian parasite, *Anagyrus antoninae* Timberlake[3], for control of the Rhodesgrass scale (*Antonina graminis* (Mask.)) in south Florida (Questel and Genung, (1957)[4]. Because the parasite is tropical and the exceptionally severe winter of 1957-58 resulted in an almost unprecedented series of freezes from late December through February that were extremely injurious to host grasses of the scale, we were concerned as to whether the parasites would survive. The direct effects of the cold on the parasites and the indirect effects of reduced numbers of the host insect and its host grasses were both considered to be important in the parasite's survival.

Host material was collected from areas where introduction had been made earlier. Collections were made after danger from frost had passed to determine whether parasites could be reared from the sample material and whether they had survived the winter. Collection and rearing methods employed have been described previously.[4]

On March 4, 1958, collections of scale-infested Para grass were made near Clewiston, Florida, where temperatures had gone as low as 21°F. After the grass was held for 10 days, more than 50 parasites emerged, showing that survival was high despite the cold. On March 21, 1958, sample material was collected near the release point in the vicinity of Lake Worth, Florida. Within five days *A. antoninae* adults were emerging, an indication that survival was good in the Lake Worth area where temperatures had dropped to 26°-28°F. In both areas scale-infested grass was scarce.

Since host grasses of the Rhodesgrass scale were so severely injured and the scales were so scarce, the logical conclusion was that the parasites must have been reduced in number. However, where living scale-infested grass stems could be found, survival of the parasites was good. Scale scarcity at centers of introduction could also be attributed to the parasite's effectiveness since observations prior to the freezes had shown that scale populations had been reduced. If these parasites are capable of surviving a winter as severe as the one described, we may reasonably assume that low temperatures will not be too serious an obstacle to permanent establishment of the parasite in the southern third of Florida.

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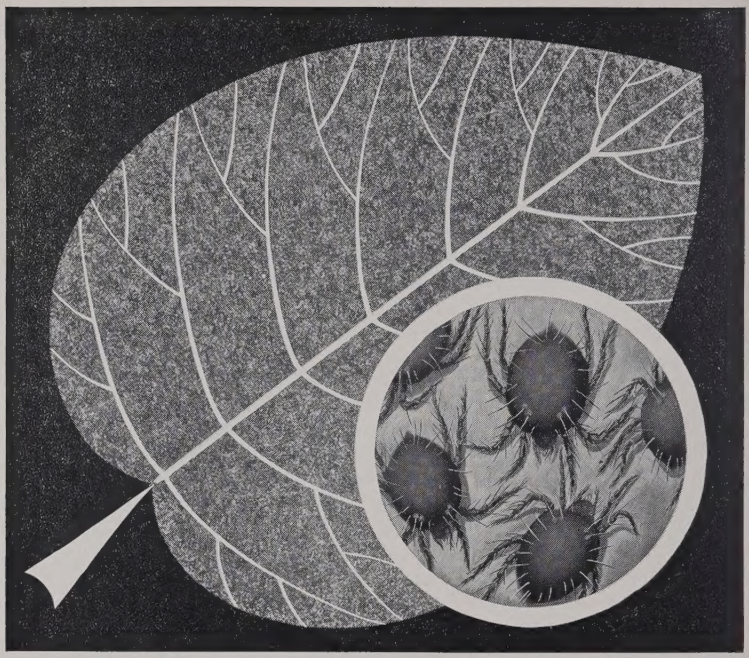
[1] Formerly Entomologist, Entomology Research Division, Agricultural Research Service, U.S.D.A., Belle Glade, Florida. Retired 1959.

[2] Associate Entomologist, University of Florida, Everglades Experiment Station, Belle Glade, Florida.

[3] Hymenoptera: Mymaridae.

[4] Questel, D. D., and W. G. Genung. 1957. Establishment of the parasite *Anagyrus antoninae* in Florida for control of Rhodesgrass Scale. Fla. Ent. 40(4): 123-125.



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A NEW SPECIES OF MALLOPHAGA FROM THE PEAFOWL

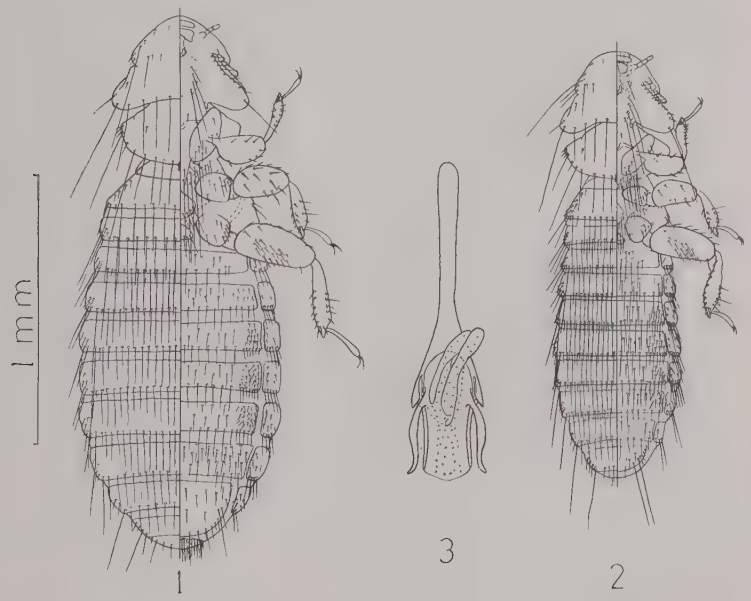
K. C. Emerson
Stillwater, Oklahoma

In an earlier paper (Emerson and Elbel, 1957)[1] it was noted that two species of *Amyrsidea* are found on the peafowl; and that the smaller of the two species was undescribed. That form is herewith described and illustrated.

Amyrsidea minuta, n. sp.

Male. General shape and chaetotaxy as shown in figure 2. Male genitalia as shown in figure 3.

Female. General shape and chaetotaxy as shown in figure 1.



Explanation of figures.

All figures pertain to *Amyrsidea minuta* n. sp. Figures 1 and 2 are drawn to the same scale.

Fig. 1. Dorsal-ventral view of female.
Fig. 2. Dorsal-ventral view of male.
Fig. 3. Male genitalia.

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[1]Emerson, K. C., and R. E. Elbel, 1957. New species and records of Mallophaga from gallinaceous birds of Thailand. Proc. Ent. Soc. Wash. 59: 232-243.

DIAGNOSIS. In general appearance and size this species resembles *A. lagopi* (Grube, 1851), *A. megalosoma* (Overgaard, 1943) and *A. perdicis* (Denny, 1942). In each of the above named species, the parameres and endomeres of the male genitalia are long, slender, and straight; while in *A. minuta* these structures are short, and the parameres are curved outward at the distal tips. The male genitalia of *A. phaeostoma* (Nitzsch, 1866) are of a different type (Emerson and Elbel, 1957)[1]. In addition, *A. phaeostoma* is almost twice as large as *A. minuta*.

TYPE MATERIAL: Holotype male allotype female, and paratypes collected by Dr. G. J. Spencer on 15 October, 1949, at Vancouver, British Columbia, Canada. Additional paratypes from the following locations: Zoological Gardens, London, England, October, 1952; Bridgnorth, Shropshire, England, 19 September, 1934; New Orleans, Louisiana, 6 December, 1918; Portland, Oregon, 17 March, 1933; and McAllen, Texas, March, 1937. The holotype and allotype are in the collection of Dr. G. J. Spencer at the University of British Columbia. Paratypes are in the British Museum (Natural History), the U. S. National Museum and the collection of the author.

ANNUAL MEETING OF THE FLORIDA ENTOMOLOGICAL SOCIETY

The annual meeting of the Society will be held jointly with those of the Entomological Society of America and the Southeastern Branch of the E.S.A. at Miami from November 27-30. Headquarters of the Florida Entomological Society and the Southeastern Branch will be at the Columbus Hotel and those of the National Society at the adjacent McAllister. Arrangements have been made to house the members of the Florida Society at the Columbus. Members registering at the Hotel should be sure to indicate their society affiliation.

The meetings of the National Society are expected to be unusually well attended. It is also hoped that the Florida organization will have the largest contingent ever to attend its annual meeting. The program should be exceptionally good and many special events have been planned by the local committees.

A NEW SPECIES OF DAMSELFLY FROM ST. LUCIA, BRITISH WEST INDIES (ODONATA: PROTONEURIDAE)

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A single male and female of a new species of *Protoneura* were taken on the upper Cul de Sac River, St. Lucia, on 7 September, 1957. No others of this species were seen, but other Odonata present included *Dythemis multipunctata* Kirby, *Enallagma coecum* (Hagen), *Ischnura ramburii credula* (Hagen), and *Ceratura capreola* (Hagen). The stream at this locality is narrow with alternate riffles and pools. The bottom is composed of sand and gravel, and there is some emergent vegetation in the quieter parts.

Protoneura ailsa, n. sp.[1]

HOLOTYPE MALE: Head pale brownish-yellow and dark iridescent magenta to copper. Labium and mandibles pale, labrum deep iridescent magenta with a broad pale anterior margin, anteclypeus pale, postclypeus deep iridescent magenta, frons and genae pale, this pale color extending along mesal side of antennae bases. Antennae dark, dorsum of head dark iridescent copper. Eyes red, rear of head dark.

Prothorax pale brownish yellow, dark as follows: dorsum of median lobe dull copper, hind lobe dusky. Posterior margin of hind lobe entire, convex.

Pterothorax pale brownish-yellow, dark as follows: mesepisternum and mesostigmal laminae dusky copper, upper half of mesinfrapisternum and mesepimeron dusky.

Legs pale yellowish, with black spines, except for distal spines of anterior tibiae, and black tips of tarsal claws. Distal ends of femora dusky.

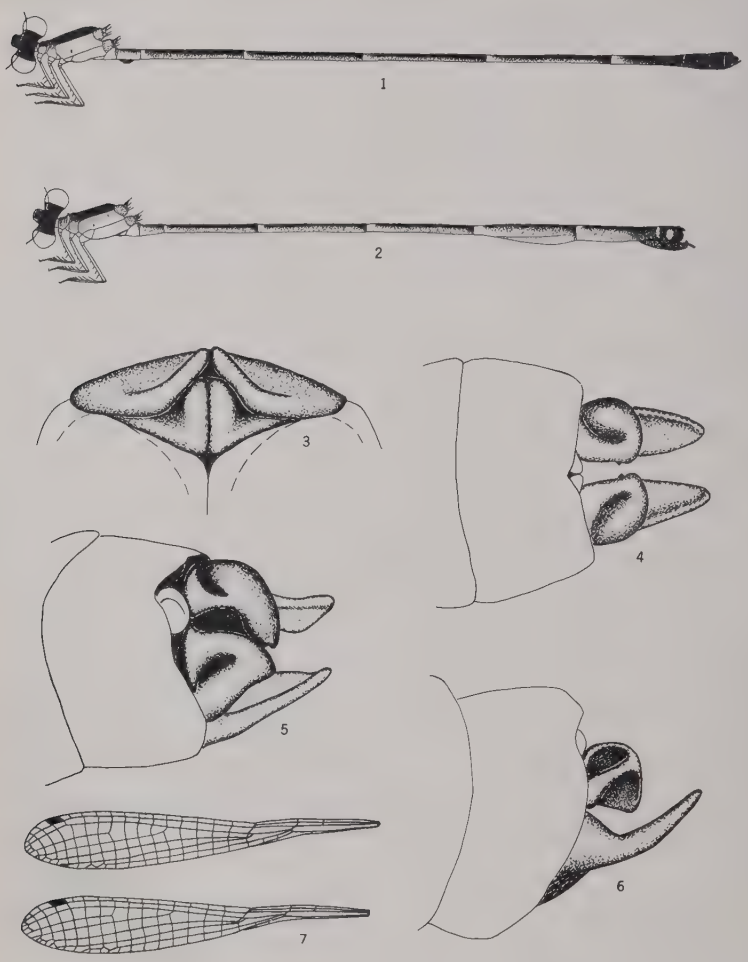
Wings with veins brownish, stigma red-brown. Width of wings about one-sixth the length, first antenodal costal space longer than the third, R_S arising at subnodus, M_3 arising proximal to subnodus, M_2 arising at fifth postnodal cross vein in fore wing and fourth in hind wing. M_3 terminates at the level of the stigma.

Abdomen dark brownish-black dorsally, obscurely pale as follows: side and anterior half of segment one, small anterior ring and lateral edges of three to six.

Appendages with superior very unusual for the genus: dark, shorter than segment ten, equant, and labyrinthine, with a recurved dorsal-mesal process, a ventral-lateral sinus, and a flattened ventral process. Inferior appendage pale, normal for the genus, twice the length of the superior, broad at the base and tapering apically with a rounded tip.

ALLOTYPE FEMALE: Head similar to male, but pale anterior border of labrum wider than in male. Dark color of the dorsum of the head iridescent

[1] The specific name is that of my wife, who not only is a keen and competent collector but who also discovered these damselflies during a brief collecting trip in St. Lucia. In selecting this name I am also perpetuating an old and honored tradition among Odonatists by giving a woman's name to an incredibly lovely damselfly.



Figures 1-7, *Protoneura ailsa*, new species. Figures 1 and 2, color patterns of male and female. Figure 3, mesostigmal laminae of female. Figures 4-6, superior appendage of male in dorsal, tilted, and lateral views. Figure 7, wings of male.

green rather than copper or magenta. Pale color of frons extending posteriorly to the rear of the antennae.

Prothorax with front and hind lobes pale, the latter narrower and more erect than in male. Median lobe dusky dorsally, as in male.

Pterothorax with mesepisternum iridescent greenish, upper half of mesinfrapisternum dusky. Pale color grayish-yellow, rather than brownish-yellow as in the male. Mesostigmal laminae dark, pale laterally and posteriorly, with a prominent bifid rounded mesal process flanked by two lateral processes pointing in a mesal-anterior direction.

Legs as in male.

Wings as in male. One front wing has M_2 arising between the fifth and sixth postnodal cross veins and the other at the fifth cross vein.

Abdomen dark dorsally with obscure pale anterior bands on segments three (narrow) to six, a very obscure pale anterior band on seven, and pale lateral spots on eight and nine. Sterna of six and seven distended ventrally. Ventral margin of valves of ovipositor finely serrated apically.

Dimensions: Total length: male 38 mm.; female 34 mm. Abdomen: male 33 mm.; female 29 mm. Hind wing: male 17 mm.; female 19 mm.

Type locality: Cul de Sac River, near Bexon, Castries Quarter, St. Lucia, British West Indies. Specimens collected on 7 September, 1957. Holotype male and allotype female in the collection of the University of Florida.

The general appearance and wing venation of this species are typical for *Protoneura* s. str. as defined by Williamson (1915, pp. 616-625)[2] However, this species is immediately set apart from all others in the genus by the most peculiar labyrinthine superior appendage of the male. The female resembles that of *P. capillaris* (Rambur) but has mesostigmal laminae of a different shape. The other West Indian *Protoneura* is *capillaris*, which is abundantly distinct from *ailsa*. There is a good possibility that the so-called *capillaris* from Puerto Rico and the Virgin Islands may have to be referred to another species (Westfall, personal communication), but this problem is in no way related to that of the relationship between *ailsa* and *capillaris* s. lat. The new species *ailsa* is dominantly red in the male, whereas *capillaris* is dominantly blackish and violet (Cuba) or iridescent blue-green (Virgin Islands). The superior appendage of *ailsa* is short, equant, and labyrinthine, whereas that of *capillaris* s. lat. is as long as the inferior, subcylindrical, with a ventral apical tooth.

I would like to acknowledge discussions of the *Protoneura capillaris* problem with Minter Westfall, who also criticized this manuscript. Harold Grant, D. E. Kimmins, and Ashley Gurney kindly made available the collections of the Academy of Natural Sciences, Philadelphia, the British Museum, and the United States National Museum, respectively.

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[2] Williamson, E. B. 1915. Notes on Neotropical dragonflies, or Odonata. Proc. U.S. Nat. Mus., 48: 601-638.

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LABORATORY TESTS OF SELECTED HOUSE FLY REPELLENTS

H. G. Wilson, G. C. LaBrecque, and J. B. Gahan
Entomology Research Division, Agric. Res. Serv., U.S.D.A.

The rapid development of resistance to insecticides in house flies (*Musca domestica* L.) indicates an urgent need for other approaches or alternate means for their control. The use of repellents appears to be practicable in restricted areas and under favorable conditions to relieve the annoyance caused by these insects and to reduce the contamination which is associated with their presence. LaBrecque and Wilson (1959)[1] reported the results of laboratory tests with 65 compounds as vapor or contact repellents to house flies. This paper presents the results with 26 additional chemicals tested by the same methods. Some of the compounds were received from commercial laboratories where they had been developed as fly repellents and others were selected because they showed repellency in other types of tests conducted at our laboratory.

Briefly, the test method was based on the numbers of female flies caught in 30 minutes in traps made of drinking glasses baited with Edamin (a casein hydrolysate) and capped with white cardboard funnels. The number caught in a trap with an untreated funnel divided by the number in a trap with a treated funnel gave the repellency ratio. The repellents were applied at 200 milligrams per square foot, and treated funnels were tested after various periods of aging up to 12 weeks, or until the repellency ratio fell below two.

The results with 12 compounds that gave ratios above two after aging for two days or longer are given in table 1. Four compounds were effective throughout the entire 12-week testing period, namely *n*-octylsulfinylbutyronitrile, decyl lactate acetate, *n*-octylmercaptobutyronitrile, and diisohexylamine. Deet, which has been outstanding as a repellent for personal protection against mosquitoes and biting flies, was effective for two weeks.

The following compounds gave ratios of less than two during the first two days of aging:

ENT. No.	Repellent
20302-b	*N,N*-Diethylseneciamide
18421	Tricarbethoxymethane
21557	6-Chloropiperonyl chrysanthemumate
26233	4,4-Dimethyl-*m*-dioxane
26284	4,4-Dimethyl-5-*m*-dioxanemethanol
26287	2-Ethylhexylamine
26299	Hydrazide of *m*-toluic acid
30146	*N,N*-Dibutyl-*p*-toluamide
30436	Cyclohexyl formate
30486	Tetrahydro-2-furfuryl formate
30490	2,2-Dimethyl-1,3-propanediol diformate

[1] LaBrecque, G. C., and H. G. Wilson. 1959. Laboratory tests with sixty-five compounds as repellents against house flies. Fla. Ent. 42(4): 175-177.

30491 1-Allyloxy-3-chloro-2-propyl formate
30492 2,2,4-Trimethyl-1,3-pentanediol diformate
30494 1-Allyloxy-3-chloro-2-propyl acetate

TABLE 1.—EFFECTIVENESS OF 12 COMPOUNDS AS HOUSE FLY REPELLENTS IN GLASS TRAP TESTS. (AVERAGE OF TWO REPLICATIONS.)

Code No. ENT-	Repellent	Ratio of repellency at indicated days of aging						
		Days		Weeks				
		1	2	1	2	4	8	12
26029	*n*-Octylsulfinyl-butyronitrile	9.8	7.7	3.1	6.4	26.0	4.5	5.3
15705	Decyl lactate acetate	6.4	4.4	2.1	3.8	2.6	2.1	2.2
26028	*n*-Octylmercapto-butyronitrile	1.9	15.3	8.0	13.0	16.5	2.8	2.0
16568	Diisohexylamine	54.0	22.5	4.4	2.8	2.4	2.0	2.1
26033	3-Chloro-2-hydroxy-propyl *n*-octyl sulfide	15.0	12.3	10.3	4.2	15.5	2.7	<1
26030	3-*n*-Octylmercapto-tetrahydrothio-phene-1,1-dioxide	4.0	2.8	3.0	3.7	8.1	1.8	—
16562	Nonylamine	14.0	18.3	2.7	3.2	2.0	<1	—
16575	Trihexylamine	28.0	6.7	9.5	3.3	1.9	—	—
30126-a	*N,N*-Dibutyl-*m*-toluamide	15.3	4.3	8.6	4.9	1.7	—	—
22542	Deet (*N,N*-diethyl-*m*-toluamide)	20.3	17.3	4.3	3.9	1.0	—	—
25469-X	Pyrethrins (Kenya Oleo Resin, 25%)	2.8	2.8	1.2	—	—	—	—
26282	4,5-Dimethyl-*m*-dioxane	1.3	2.5	<1	—	—	—	—

TWO NEW CHIRONOMIDAE (DIPTERA) AND ADDITIONAL STATE RECORDS FROM FLORIDA

Elisabeth C. Beck
Bureau of Entomology, Florida State Board of Health

Since the publication of a checklist of Chironomidae of Florida (Beck and Beck, 1959), 21 additional species have been collected in Florida, two of which are new. Collection records in this paper followed by (WMB) were those of W. M. Beck, Jr., made while he was conducting biological surveys for the Florida State Board of Health, Bureau of Sanitary Engineering. All other specimens were taken in mosquito light traps operated by the Florida State Board of Health, Bureau of Entomology.

New State Records

Pentaneura annulata (Say). Keystone Heights, 16 Dec., 1955; Orange County, 15 Oct., 1957 (WMB).

Anatopynia fastuosa (Joh.). Blountstown, 4 April, 1958.

Pseudochironomus middlekauffi Townes. Miami, 14 Jan., 1958.

Lauterborniella agrayloides (Kieffer). Clay County, Bull Creek, 18 April, 1958 (WMB).

Omisus pica Townes. Bonifay, 7 Apr., 1958.

Paratendipes subaequalis (Malloch). Chattahoochee, 13 July, 1956.

Kribioxenus bicornis Townes. Keystone Heights, 6 May, 1959.

Kribioxenus mirabilis Townes. Moorehaven, 20 Nov., 1959.

Polypedilum griseopunctatum (Malloch). Chumuckla, 4 Aug., 1958 (WMB); Kenansville, 29 Apr., 1958; Walton County, small creek on US # 98, 8 Apr., 1958 (WMB).

Polypedilum gomphus Townes. Chumuckla, 4 Aug., 1958 (WMB).

Polypedilum braseniae (Leathers). Tallahassee, 19 June, 1957 (WMB).

Stenochironomus poecilopterus (Mitchell). Chattahoochee, 28 Mar., 1961.

Chironomus (*Chironomus*) *riparius* Meigen. Madison, 12 June, 1957.

Chironomus (*Tribelos*) *ater* (Townes). Leesburg, 8 Apr., 1958.

Chironomus (*Tribelos*) *jucundus* var. *jucundus* Walker. Bonifay, 10 Mar., 1958.

Chironomus (*Cryptochironomus*) *sorex* (Townes). Myakka State Park, 9 Nov., 1960; Lakeland, 6 Apr., 1954; Crestview, 12 Apr., 1954 (WMB).

Chironomus (*Cryptochironomus*) *scimitarus* (Townes). Myakka State Park, 13 June, 1960.

Chironomus (*Cryptochironomus*) *amachaerus* (Townes). Goose Prairie, 13 Jan., 1961.

Chironomus (*Cryptochironomus*) *undine* (Townes). Keystone Heights, 24 Jan., 1958.

Chironomus (*Cryptochironomus*) *curtilamellata* Malloch. Jacksonville, 10 Apr., 1960.

Glyptotendipes meridionalis Dendy and Sublette. Hernando County, 27 Sept., 1960 (WMB); Orange County, Sept., 1960 (WMB); Wewahitchka, 9 Sept., 1960; Chattahoochee, 13 Sept., 1960.

The two following species are previously undescribed. Disposition of types is indicated in parenthesis after data: United States National Museum (USNM), University of Florida Collection (UF), Dr. James E. Sublette (JES). All other types are in the collection of the Florida State Board of Health, Bureau of Entomology.

The following abbreviations (following Dendy and Sublette, 1959) are used:

L.R.—Leg ratio
A.R.—Antennal ratio
D.M.—Dorsomedian
D.L.—Dorsolateral
P.A.—Prealar

Chironomus (*Nilodorum*) *devineyae* n. sp.[1]

Male Holotype: St. James City, Florida, 21 Jan., 1958. (USNM)

Wing 1.6 mm. long; A.R. 1.0; L.R. 1.7 (paratype, foretarsi are missing on the holotype). Palpal segments very short, only 1½ times as long as wide, in proportion of 6:10:10:12; frontal tubercles absent; pronotum distinctly projecting medially, with deep median notch.

Thorax light brown; mesonotal vittae, postnotum, scutellum, sternum and small pleural markings blackish brown, the lateral vittae darker than the median ones. D.L. in single row, bistles far apart; P.A. bristles 4-5; D.M. in a double row; scutellum with transverse row of 6-7 large bristles; halters light brown; legs brown.

Abdomen uniformly dark brown. Wing tinged with brown, the veins brown; fork of Cu well beyond r-m; C and R_{1+5} curving posteriorly to end at wing apex; ends of R_{2+3} and R_4 distinctly separated; squama with long thick fringe of hairs.

Foretibia with inner apical low rounded scale; combs of middle and hind tibiae close, but with a distinct notch between, each with a strong spine; pulvilli conspicuous; foretarsi not bearded.

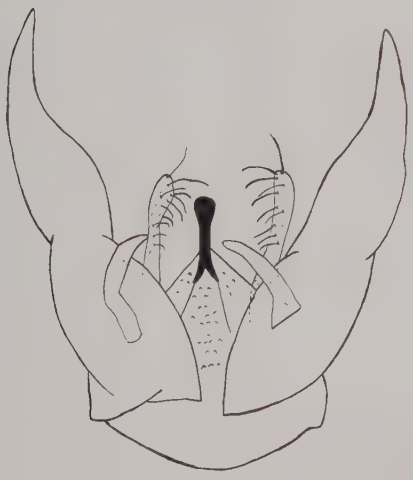
Genitalia: (Fig. 1) Genitalia conspicuous, more thickened dorso-ventrally than usual. Style long and slender, curved inward, narrowing to a point. Anal point black, broader at tip; inferior appendage slender, somewhat club-shaped; superior appendage brown, long, curved, pointed at apex, with only microtrichia near the base.

Female: unknown.

Paratypes: 2 males, Big Pine Key, Fla., 5 Sept., 1957; 6 Sept., 1960. 3 males, Rock Harbor, Fla., 17 Dec., 1957. 21 males, Allenhurst, Fla., 7 Mar., 1958. 3 males, Sanibel, Fla., 3 Jan., 1958. 3 males, Ft. Myers, Fla., 6 Aug., 1957; 30 July, 1957. 6 males, Ozello, Fla., 16 Sept., 1960. 7 males,

[1] I am naming this species in honor of Dr. Ezda M. Deviney.

New Smyrna Beach, Fla., 1 Nov., 1960, (JES, one). 1 male, Vero Beach, Fla., 14 Jan., 1958, (UF); many males, 28 Feb., 1958; 28 Oct., 1960. 1 male, Santa Rosa, Fla., 9 Aug., 1957. 14 males, Everglades City, Fla., 24 Jan., 1958, (USNM, one); 27 Oct., 1960; 29 Oct., 1960; 1 Nov., 1960; 6 Dec., 1960. 1 male, Naples, Fla., 6 Apr., 1956.



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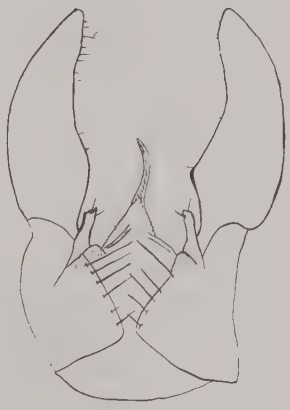

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Legend

Figure 1. Male genitalia, *Chironomus* (*Nilodorum*) *devineyae*, n. sp.
Figure 2. Male genitalia, *Chironomus* (*Cryptochironomus*) *sublettei*, n. sp.

The abdomen varied in color from olive green to dark brown. Wing length, range 1.4-1.6; mean 1.49 mm (5); leg ratio, range 1.5-1.7; mean 1.6 (3); Antennal ratio, range .83-1.1; mean .98 (3). The species apparently occurs throughout the year.

Diagnosis: This find represents the first record of the subgenus from the Nearctic region. The species differs from those described by Freeman (1957) in several genitalic features. However, the structure of the pronotum, the absence of frontal tubercles, and the reduced mouthparts would indicate inclusion in *Nilodorum*. The reduced mouthparts together with the distinctive genitalia serve to separate this species from all other nearctic forms.

Chironomus (*Cryptochironomus*) *sublettei*, n. sp.[2]

Male Holotype: Everglades City, Florida, 1 Nov., 1960 (USNM).

Wing 1.4 mm long; L. R. 1.4; A. R. 1.7. Frontal tubercles very small, only about as long as their diameter. Palpal segments in ratio of 15:33: 48:76. (paratype).

[2] It is with pleasure that I name this species in honor of Dr. James E. Sublette.

Thorax pale tan; P. A. bristles 3-4; D. L. in single row; D. M. in double row; scutellum with two large apical bristles and about 6-8 finer bristles in a transverse row; head, antennal flagellum, mesonotal vittae, and forelegs light brown, mid and hind legs stramineous with distal tarsal segments darkened.

Abdomen pale green, becoming brown toward apex. Wing pale, anterior veins slightly darkened; squama with only 1 hair.

GENITALIA: (Fig. 2) Style stout with lobe-like swelling on inner margin, sometimes rather acute; superior appendage rod-shaped with irregular pointed apex bearing two setae.

FEMALE: unknown.

PARATYPES: 2 males, Everglades City, Fla., 1 Nov., 1960 (JES, one; UF, one). 1 male, Floral City, Fla., 2 July, 1957. 2 males, Sanibel, Fla., 5 Nov., 1957; 1 male, 9 Aug., 1957. 1 male, Ft. Myers, Fla., 25 Oct., 1957.

Wing length, range 1.4-1.7; mean 1.45 mm. (5); leg ratio, range 1.36-1.4; mean 1.38 (3); antennal ratio, range 1.3-1.7; mean 1.45 (4). The abdomen in this species is often pale tan, rather than green, with the base of each abdominal segment slightly darkened. All specimens are from light traps. The species was taken throughout the year.

DIAGNOSIS: This species superficially resembles *abortivus* Malloch in the shape of the superior appendage of the male genitalia. However, the well-developed inferior appendage, beset with conspicuous microtrichia, and the unusually heavy style serve to distinguish this species from *abortivus* as well as all other nearctic forms.

I wish to express my appreciation to Dr. J. E. Sublette and to W. M. Beck, Jr., for help with this manuscript.

SUMMARY

Records are given for 21 species of Chironomidae not previously recorded from Florida. New species *Chironomus* (*Cryptochironomus*) *sublettei* and *Chironomus* (*Nilodorum*) *devineyae* are described. The latter represents the first Nearctic record for the subgenus *Nilodorum*. These 23 species bring the total known Chironomid fauna of Florida to 133.

LITERATURE CITED

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Freeman, Paul. 1957. A study of the Chironomidae (Diptera) of Africa south of the Sahara. Part III. Bull. Brit. Mus. (Nat. Hist.) Ent., 5: 32-426.

AN ANNOTATED LIST OF THE PSOCOPTERA OF THE FLINT-CHATTAHOOCHEE-APALACHICOLA REGION OF GEORGIA, FLORIDA, AND ALABAMA

EDWARD L. MOCKFORD[1]

The Flint-Chattahoochee-Apalachicola Region of Georgia, Florida, and Alabama has been of interest to students of natural history in the Southeastern States for many years. A survey of the biota of this region was undertaken by the Florida State Museum when part of the area became threatened with inundation (Hubbell et al., 1956). In order to collect psocids for the survey, I visited this region with other biologists from the University of Florida in June, 1953, and again in March, 1954. Prior to the initiation of the survey, I had made two collecting trips to Torreya State Park, Florida. This paper is based primarily on the specimens taken on these four trips. In addition, some specimens are treated which were collected by P. B. Kannowski and T. J. Cohn on a trip to this region in June, 1956. I also include the very few literature records of psocids from the area (distribution records of Chapman, 1930).

To date only 38 species of psocids have been found in the region under consideration. I believe that this represents less than half of the number of species which actually occur there, for the Florida psocid fauna far exceeds 100 species, and the great variety of habitats in the Flint-Chattahoochee-Apalachicola region probably harbor many species. Also, the fact that two undescribed species known only from this region are represented by a single specimen each, indicates that much more collecting is needed before the fauna becomes well known.

Until 1952, the states of Georgia, Florida, and Alabama comprised almost virgin territory for psocid collecting. This is still true of Georgia and Alabama, but Florida is now somewhat better known. Nevertheless, very little conclusive evidence can be presented about the ranges of the species treated in this paper.

HABITATS: After much collecting over a wide area, one becomes aware that certain situations merit close attention for psocid habitation in contrast to a set of situations in which psocids cannot live. Generally, any terrestrial community is liable to have at least a few psocids. Hence, psocids are to be found in all of the terrestrial communities discussed by Hubbell et al. (1956: 29-38), with the possible exception of "lawns and grazed meadows", and "bulldozed floodplain areas". Generally, psocids are more abundant and varied in forest communities than in those of shrub and grassland. The small size and poor mobility of a psocid restrict its ability to utilize the "whole environment" offered by a major plant community. Therefore, such a community offers a whole host of habitats, each with its assemblage of psocids, consisting frequently of a few obligate species and many facultative species. The major plant community determines the distribution of these assemblages only insofar as it determines the distribution of their habitats. Thus an accumulation of leaf litter from broad-leaved trees may carry the same obligate species of psocids in a dry oak-

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land that it does in a ravine forest. Likewise, a clump of the epiphyte Spanish moss on a cypress branch in a cypress pond is liable to contain the same assemblage of psocids that occurs in Spanish moss on a magnolia branch in a sandy hammock. In the two examples cited, the psocid habitat offers considerably more stable moisture, temperature, and food supply than the surrounding environment, and this is probably an important clue to the distribution of all small, rather immobile organisms.

The psocid habitats investigated in the study area and their obligate species are presented in table I. The obligate species of this table are either known to be obligate throughout their range or are considered obligate on the basis of certain morphological characters which are probably adaptive for the habitat. The fact that several habitats have no obligate species is easy to understand in some cases. Fence posts are virtually the same habitat as tree trunks. Most of the foliage of the broad-leaved, dicotyledonous trees and shrubs falls to the ground in this region in the winter, and psocids of this habitat occur in the ground litter in early spring. Most psocids apparently do not distinguish between Spanish moss and dry leaves on a branch. The virtual absence of psocids from cane (*Arundinaria tecta*) is not so readily explicable. It probably indicates that cane bears a very scanty epiphytic microflora.

Table I. Psocid Habitats of the Chattahoochee Region and Their Obligate Species

Habitat	Obligate Species
1. Conifer foliage	*Lachesilla contraforcepeta*
2. Trunks and branches of broad-leaved trees in forests	*Metylophorus purus*
3. Fence posts on roadside	None (*Hyalopsocus floridanus* taken in no other habitat, but found elsewhere on trees).
4. Foliage of broad-leaved dicotyledonous trees and shrubs	None found
5. Dry leaves of dicotyledonous trees on branches	*Lachesilla anna*, *Lachesilla* sp. c.
6. Dry needle palm leaves	*Lachesilla* sp. a
7. Spanish moss (in dry, mesic woods)	None, but several species taken in no other habitat in this area.
8. Dry grass in old field	*Caecilius* sp. g.
9. Cane in ravine	None
10. Ground litter	*Lepolepis occidentalis*
11. Under loose bark of dicot. trees	*Embidopsocus* sp. a, *Belaphotroctes* sp.

Classification: The family classification used in this paper is essentially that of Pearman (1936) with minor modifications.

Names of Plants: Common names of plants used in this paper, with their corresponding scientific names, are given on the following list. Sci-

entific names are from *Gray's Manual of Botany* (8th edition, 1950) and J. K. Small's *Manual of the Southeastern Flora* (1933).

List of the plant species on which collections were made:

Loblolly pine	*Pinus taeda*
Long-leaf pine	*Pinus australis*
Cypress	*Taxodium distichum*
Torreya	*Tumion taxifolium*
Florida yew	*Taxus floridana*
Needle palm	*Rhapidophyllum Hystrix*
Cane	*Arundinaria tecta*
Spanish moss	*Tillandsia usneoides*
Magnolia	*Magnolia spp.*
Sweet gum	*Liquidambar styraciflua*
Beech	*Fagus grandifolia*
Hornbeam	*Carpinus caroliniana*
Hickory	*Carya spp.*
Post oak	*Quercus stellata*
Maple	*Acer spp.*

LOCALITIES: The following code of abbreviations is used in the distribution records in this paper.

Florida localities:

Fla. 1—Jackson County, State Road 71, 6.6 miles south of junction with U. S. Highway 90.
Fla. 2—Liberty County, Torreya State Park.
Fla. 3—Liberty County, 1.5 miles north of Bristol.
Fla. 4—Liberty County, Rock Bluff.
Fla. 5—Liberty County, 2.5 miles northeast of Bristol.
Fla. 6—Gadsden County, Apalachicola River near Chattahoochee.
Fla. 7—Gadsden County, Chattahoochee.
Fla. 8—Gadsden County, Mosquito Creek south of Chattahoochee.
Fla. 9—Gadsden County, Woodruff Dam Site, block 411.
Fla. 10—Calhoun County, 2.8 miles south of Altha on State Road 71.

Georgia Localities:

Ga. 1—Decatur County, Woodruff Dam Site block 420.
Ga. 2—Decatur County, Woodruff Dam Site blocks 417, 381, and 385.
Ga. 3—Decatur County, 2.9 miles south of Faceville on State Road 97.
Ga. 4—Decatur County, about 5 miles south of Faceville on State Road 97.
Ga. 5—Decatur County, Woodruff Dam Site, block 368 (Mosquito Creek Hammock).
Ga. 6—Seminole County, Chattahoochee River at Florida State Line.
Ga. 7—Seminole County, Spring Creek.

Alabama Localities:

Ala. 1—Houston County, Chattahoochee State Park.
Ala. 2—Houston County, Irwin Mill Creek.

List of Species

Family Lepidopsocidae

1. *Echmepteryx hageni* (Packard)

Amphientomum hageni Packard, 1871, p. 405.

This scaly-winged psocid is widespread in eastern North America. It occurs on trunks and branches of trees, and on stone outcrops.

Records: Fla.-2, Aug. 22, 1951, on trunk of beech in ravine forest, 1 ♀. Ala.-1, June 3, 1953, beating Spanish moss in dry mesic woods, 1 ♀. Ala.-2, June 3, 1953, beating loblolly pine foliage and branches, nymphs. Ga.-6, June 14, 1956, 1 nymph.

2. *Lepolepis occidentalis* Mockford

Lepolepis occidentalis Mockford, 1955, p. 436.

An obligate of ground litter, this normally brachypterous scaly-winged psocid has a wide range in eastern North America. A macropterous female taken in the study area is the second macropterous specimen known.

Records: Fla.-9, June 2, 1953, sifting ground litter on hillside in hickory woods, 1 nymph. Fla.-5, March 27, 1954, sifting ground litter on dry slope in mixed hardwood-pine forest, 9 nymphs. Ala.-2, June 3, 1953, sifting ground litter under loblolly pines, 2 nymphs. Ga.-3, June 22, 1956, 1 macropterous ♀.

Family Psoquillidae

3. *Rhyopsocus phillipsae* Sommerman

Rhyopsocus phillipsae Sommerman, 1956, p. 146.

Of the four species of *Rhyopsocus* now known from North America (Sommerman, 1956; Mockford and Gurney, 1956: 357) this is perhaps the one with the widest range.

Records: Fla.-2, June 3-4, 1952, on needle palms, mostly dry leaves, 8 ♂, 8 ♀. Fla.-2, June 4, 1953, under loose bark of dead trees, 1 ♂, 2 nymphs. Ala.-1, June 3, 1953, beating Spanish moss in dry mesic woods, 12 ♂, 6 ♀, 33 nymphs.

Family Liposcelidae

4. *Belaphotroctes* sp.

The genus *Belaphotroctes* has not previously been recorded from the Western Hemisphere. Three species have been described, one from the Congo (Badonnel, 1949) one from Angola (Badonnel, 1955) and another from Natal (Ribaga, 1911). The species listed here is probably new and has been taken at several Florida localities.

Records: Fla.-2, June 4, 1953, under loose bark of dead trees, 5 apterous ♀, 5 nymphs.

5. *Embidopsocus* sp. a

Like most other members of its genus, this undescribed species inhabits the space between loose bark and wood of trees, usually dead ones. It has

been found at several localities in Peninsular Florida, but it has not been taken north of the study area. It is being described in a separate work.

Records: Ga.-6, June 3, 1953, under loose bark of small dead tree, 1 macropterous ♀. Fla.-2, June 4, 1953, under loose bark of dead trees, 1 macropterous ♀, 1 apterous ♀.

6. *Liposcelis bostrychophilus* Badonnel

Liposcelis bostrychophilus Badonnel, 1931, p. 250.

Since my specimens show many characters in common with this Afro-European species, I believe that they are identical with it. The species has a wide range in eastern United States, where it is often subcorticolous. In Europe and Africa it has been found only in domestic situations and on cultivated plants.

Records: Fla.-2, June 3-4, 1952, on dry needle palm leaves, 3 ♀. Fla.-2, June 4, 1953, under loose bark of dead trees, 1 ♀. Fla.-7, June 3, 1953, at light, 1 ♀. Fla.-9, June 2, 1953, beating foliage of broad-leaved trees and shrubs along stream, 1 ♀. Ga.-1, June 21, 1956, 1 ♀. Ga.-2, June 18, 1956, 3 ♀, 1 nymph.

7. *Liposcelis liparus* group sp.

There are at least two species near *L. liparus* Broadhead (1947) in North America. The species from the study area lacks a bristle anterior and medial to the humeral seta and is apparently somewhat darker than the British species.

Records: Fla.-2, Aug. 23, 1951, on trunk of long-leaf pine, 1 ♀. Ga.-1, June 21, 1956, 1 ♀.

8. *Liposcelis* sp. a

An undescribed species with very distinctive markings is frequently encountered in Florida. It has been taken several times in the study area.

Records: Fla.-2, August 23, 1951, on dry needle palm leaves, 1 ♀. Ala.-1, June 3, 1953, in Spanish moss, 1 ♀, 1 nymph.

9. *Liposcelis* sp. b

This is an undetermined species apparently near *L. hirsutus* (Badonnel).

Record: Fla.-2, June 2, 1952, on tree trunk, 1 ♀.

Family Caeciliidae

10. *Caecilius* sp. a

A small, distinctively marked, undescribed species is frequent throughout much of Florida.

Records: Fla.-2, June 3, 1952, on foliage of Torreya, 1 ♀. Fla.-10, August 22, 1951, on foliage of trees in bayhead, 2 ♂, 2 ♀, 1 nymph.

11. *Caecilius* sp. g

This is an undescribed species known from a single male in Alabama and several Florida localities.

Records: Ala.-2, June 3, 1953, sweeping dry *Andropogon*, 1 ♂.

12. *Caecilius pinicola* Banks

Caecilius pinicola Banks, 1903, p. 238.

This species is found throughout the eastern United States, largely on conifers.

Records: Fla.-2, June 4, 1952, beating dry oak leaves on branch, 1♂, 1♀, 1 nymph. Fla.-2, March 27, 1954, beating needle palm, *Pinus echinata*, Torreya, and yew, 1♂. Fla.-3, March 27, 1954, beating pine and hardwood foliage in forest, 2♀, 4 nymphs. Fla.-4, April 4, 1927, 1♂. Ga.-2, June 17, 1956, 1♀.

13. *Caecilius sommermanae* Mockford

Caecilius sommermanae Mockford, 1955, p. 438.

This species has a wide range in eastern North America, extending far down the Florida Peninsula. It is an inhabitant of forests, where it may be found in a variety of habitats.

Records: Fla.-2, June 3-4, 1952, beating Torreya foliage, cane, dry oak leaves on branch, and needle palm leaves, 1♂, 14♀. Fla.-2, March 27, 1954, beating bushes in hardwood-pine forest, 1♀.

Family Amphipsocidae

14. *Teliapsocus conterminus* (Walsh)

Psocus conterminus Walsh, 1863, p. 185.

This is a common species in the Southeastern States on the leaves of forest shrubs and saplings.

Records: Fla.-8, June 5, 1953, on foliage of woody plants in mesic hardwood forest, 2♂. Fla.-10, August 22, 1951, beating foliage of trees in bayhead, 1♀. Ga.-1, June 2, 1953, on Torreya foliage, 1 nymph. Ga.-7, April 11, 1927, 1♂.

Family Polypsocidae

15. *Polypsocus corruptus* (Hagen)

Psocus corruptus Hagen, 1861, p. 13.

This is a common forest species in the eastern United States, ranging south into southern Florida. Nymphs may be found in ground litter in the spring, while all stages occur on foliage of shrubs and saplings later in the summer.

Records: Fla.-2, June 3-4, 1952, on tree trunks, Torreya foliage, needle palm leaves, and magnolia leaves in ravine forest, 5♂, 6♀. Fla.-2, June 4, 1953, beating branches of broad-leaved trees, 1♂, 1♀. Fla.-2, March 27, 1954, beating needle palm, *Pinus echinata*, Torreya, and yew in ravine forest, 1 nymph. Fla.-5, March 27, 1954, sifting ground litter on dry slope in hardwood-pine forest, 3 nymphs. Fla.-5, June 5, 1953, beating general foliage of woody plants in mesic forest, 1♀.

Family Lachesillidae

16. *Lachesilla anna* Sommerman

Lachesilla anna Sommerman, 1946, p. 636.

The species of *Lachesilla* are largely inhabitants of dry plant material, and are frequently found in dry leaves hanging on branches. *L. anna* is often encountered in that habitat and is widespread in the Eastern States.

Records: Fla.-2, June 4, 1952, in dry oak leaves on branch (ravine forest) 3♂, 1♀.

17. *Lachesilla* sp. a

An undescribed species very closely related to *L. anna* was found in the study area.

Records: Fla.-2, August 23, 1951, on needle palm leaves, 3♀. Fla.-2, June 3-4, 1952, on needle palm leaves, 10♂, 5♀, 3 nymphs.

18. *Lachesilla* sp. b.

A single male representing an undescribed species of unknown affinity was collected in the area of the survey.

Records: Fla.-2, June 4, 1952, in dry needle palm leaves, 1♂.

19. *Lachesilla* sp. c

A female and three nymphs of an undescribed species near *L. chapmani* Somm. were taken in the area.

Records: Fla.-2, March 27, 1954, in dry beech leaves, 1♀, 3 nymphs.

20. *Lachesilla contraforcepeta* Chapman

Lachesilla contraforcepeta Chapman, 1930, p. 347.

This species is widely distributed in North America and is generally confined to conifer foliage. In the survey area adults have been taken on foliage of Torreya, pine, and Florida yew.

Records: Fla.-2, June 3, 1952, beating Torreya foliage in ravine forest, 4♂, 14♀, 9 nymphs. Fla.-2, June 4, 1952, beating *Pinus echinata* foliage, 1♂. Fla.-2, March 27, 1954, beating Torreya, needle palm, *Pinus echinata*, and yew in ravine forest, 3♀.

21. *Lachesilla corona* Chapman

Lachesilla corona Chapman, 1930, p. 350.

This species apparently reaches its southern limit in the area under investigation.

Records: Ala.-1, June 3, 1953, beating Spanish moss, 2♀.

22. *Lachesilla forcepeta* Chapman

Lachesilla forcepeta Chapman, 1930, p. 348.

Although widely distributed and often abundant in eastern North America, only five individuals of this species have been collected in the area of this study.

Records: Fla.-2, August 22, 1951, on pine foliage, 1♀. Ala.-1, June 3, 1953, in Spanish moss, 2♂, 1♀, 1 nymph.

23. *Lachesilla nubilis* (Aaron)

Caecilius nubilis Aaron, 1886, p. 13.

A single male of this species was taken in the survey.

Record: Fla.-7, June 3, 1953, at light, 1 ♂.

Family Peripsocidae

24. *Ectopsocus meridionalis* Ribaga

Ectopsocus briggsi var. meridionalis Ribaga 1904, p. 294.

In a separate paper (Mockford, 1959), I have recorded this species from North America and have discussed its range. It occurs primarily on foliage of shrubs and trees and on dry leaves on branches. Numerous specimens were taken in the survey.

Records: Fla.-2, June 3-4, 1952, on needle palm leaves, 1 ♀. Fla.-2, June 4, 1952, beating dry oak leaves on branch, 3 ♀. Fla.-2, June 4, 1953, beating branches of broad-leaved trees in ravine forest, 1 ♀. Fla.-2, March 27, 1954, beating bushes in hardwood-pine forest, 1 ♀. Ga.-1, June 2, 1953, beating ferns, dry leaves on branch, and Torreya foliage in ravine forest, 3 ♀, 13 nymphs. Ga.-2, June 2, 1953, beating branches and foliage of broad-leaved trees, 12 ♀, 1 nymph.

25. *Ectopsocus dimorphus* Mockford and Gurney

Ectopsocus dimorphus Mockford and Gurney, 1956, p. 363.

The easternmost record of this curious dimorphic species was taken in the survey area.

Record: Ga.-2, June 2, 1953, sifting ground litter on recently cleared hillside, 2 ♂.

26. *Ectopsocopsis pumilis* (Banks)

Peripsocus pumilis Banks, 1920, p. 313.

This species is common in the area on dry plant material.

Records: Fla.-6, June 1, 1953, beating dead sweet gum leaves on branch, 1 ♀. Ga.-1, June 2, 1953, beating dry leaves on branch, 1 ♂, 4 ♀. Ga.-2, June 2, 1953, beating dry leaves on branch, and live post oak foliage, 2 ♂, 3 ♀, 4 nymphs. Ga.-3, March 28, 1954, beating dry sweet gum leaves on branch, 2 ♀. Ga.-7, April 11, 1927, 2 ♂. Ala.-2, June 3, 1953, beating dry leaves on branch, 1 ♀.

27. *Peripsocus quadrifasciatus* (Harris)

Psocus quadrifasciatus Harris, 1869, p. 331.

This species occurs on a variety of forest habitats in the area. The presence of males is noteworthy, for they show a spotty distribution.

Records: Fla.-2, August 23, 1951, beating dead branches of trees along slough, 1 ♀, 3 nymphs. Fla.-2, June 4, 1952, beating dry oak leaves on branch, 6 ♂, 9 ♀. Fla.-2, June 4, 1953, beating branches of broad-leaved trees in ravine forest, 1 ♂. Fla.-2, March 27, 1954, beating trees and shrubs and sifting ground litter in ravine forest, 1 ♂, 1 ♀. Fla.-4, April 25, 1924, 1 ♀. Fla.-4, April 4, 1927, 1 ♀. Ala.-1, June 3, 1953, beating dry oak leaves on branch, and beating Spanish moss, 1 ♂, 2 ♀, 2 nymphs.

Family Philotarsidae

28. *Aaroniella* sp. b

This form is intermediate in certain respects between the northern *A. maculosa* (Aaron) and an apparently undescribed species in Peninsular Florida.

Record: Fla.-6, June 1, 1953, beating dead sweet gum leaves on branch, 1 ♀.

Family Psocidae

29. *Cerastipsocus venosus* (Burmeister)

Psocus venosus Burmeister, 1839, p. 778.

The large size and herding habits of this species make it conspicuous on trunks and branches of forest trees in early summer.

Records: Fla.-2, Aug. 22, 1951, sweeping Torreya, 1 ♀. Fla.-2, June 2-4, 1952, trunks of broad-leaved trees in ravine forest, 12 ♂, 5 ♀. Ga.-2, June 2, 1953, beating branches and foliage of broad-leaved trees, 6 nymphs. Ga.-5, June 20, 1956, 9 nymphs. Ga.-7, no date, 4 ♂, 3 ♀.

30. *Metylophorus novaescotiae* (Walker)

Psocus novaescotiae Walker, 1853, p. 485.

Record: Fla.-5, March 27, 1954, beating pine and hardwood foliage in forest, 8 nymphs.

31. *Metylophorus purus* (Walsh)

Psocus purus (Walsh) 1862, p. 361.

This species occurs on trunks and branches of a variety of broad-leaved forest trees in the area.

Records: Fla.-2, August 23, 1951, on trunks of hornbeam and beech in ravine forest, 2 ♂, 1 ♀. Fla.-2, August 23, 1951, at light, 1 ♂. Fla.-2, June 2-4, 1952, on trunks of broad-leaved trees, 1 ♀. Fla.-2, June 4, 1953, under loose bark of dead trees, 3 ♀, 2 nymphs. Ga.-1, June 2, 1953, on trunks of maples in ravine forest, 1 ♂, 2 nymphs.

32. *Hyalopsocus floridanus* (Banks)

Psocus floridanus Banks, 1905, p. 2.

Record: Ga.-3, March 28, 1954, on fence posts (with egg masses on north faces of posts), 5 ♂, 7 ♀, 10 nymphs.

33. *Psocus atratus* Aaron

Psocus atratus Aaron, 1883, p. 39.

Record: Ga.-1, June 2, 1953, on trunk of maple in ravine forest, 2 ♀.

34. *Trichadenotecnum slossonae* (Banks)

Psocus slossonae Banks, 1903, p. 236.

Record: Ala.-1, June 3, 1953, beating Spanish moss in dry mesic woods, 2 ♀.

35. *Blaste opposita* (Banks)

Psocus oppositus Banks, 1907, p. 165.

This species occurs on the branches of a variety of trees in the bayheads and forests of the area.

Records: Fla.-1, Aug. 22, 1951, sweeping broad-leaved foliage, 1 ♀. Fla.-2, Aug. 23, 1951, beating dead branches of trees along slough, 3 ♀. Fla.-2, June 3-4, 1952, on needle palm leaves, mostly dead, 1 ♀. Fla.-3, Aug. 23, 1951, sweeping vegetation in bayhead, 1 ♀. Fla.-8, June 5, 1953, beating woody plants in mesic forest, 1 ♂. Fla.-10, Aug. 22, 1951, sweeping foliage in bayhead, 1 ♂, 1 ♀. Ga.-2, June 2, 1953, beating branches and foliage of broad-leaved trees, 1 ♀.

36. *Blaste quieta* (Hagen)

Psocus quietus Hagen, 1861, p. 12.

This species was taken from branches of several woody plants in the area.

Records: Fla.-2, March 27, 1954, beating bushes in hardwood-pine forest, 1 nymph. Fla.-10, Aug. 22, 1951, sweeping foliage in bayhead, 1 ♂, 1 ♀, 1 nymph. Ga.-2, June 2, 1953, beating small oak in field, 1 nymph.

37. *Blastopsocus lithinus* (Chapman)

Psocus lithinus Chapman, 1930, p. 249.

Record: Fla.-2, June 3-4, 1952, on needle palm leaves, mostly dead, 3 ♀.

Family Myopsocidae

38. *Lichenomima* sp. e

This is an undescribed species which has been taken at several Florida localities.

Records: Fla.-2, Aug. 23, 1951, beating dead branches of broad-leaved trees along slough, 1 ♀.

Summary

Records are given for 38 species of Psocoptera found in the region of confluence of the Flint and Chattahoochee Rivers. The unique natural features of the region, including the endemic conifers *Tumion taxifolium* and *Taxus floridana* apparently harbor no endemic psocid species. An undescribed species of *Lachesilla*, here designated *Lachesilla sp. a*, found on needle palm, has not been collected outside of this region and may prove to be endemic. Additional collecting in this region will probably add many species of psocids to the list.

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